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(54) MULTILAYER RECORD CARRIER AND DEVICE FOR SCANNING SAID CARRIER

MEHRSCHICHTIGER AUFZEICHNUNGSTRÄGER UND VORRICHTUNG ZUR ABTASTUNG DIESES TRÄGERS

SUPPORT D'ENREGISTREMENT MULTICOUCHE ET APPAREIL DE LECTURE DE CELUI-CI

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EP 0 745 255 B1

Description

[0001] The invention relates to a record carrier according to the preamble of claim 1. Each information layer may comprise information independently of the information contents of other information layers. The information layers may coincide or be separated from each other by a spacer layer. The invention also relates to a scanning device for scanning such record carrier. During scanning, information can be written, read or erased.

[0002] A record carrier of the type described above is known from European Patent Application EP 0 426 409 A2. The known record carrier is an optical disc comprising a plurality of recording layers arranged in the thickness direction. Each recording layer comprises an identification section storing an address of the recording layer, which the identification section belongs to. A light beam for data recording of data production can be focused on one of the recording layers. To find a specific layer, the position of the focus of the light beam is changed over a range comprising maximal all recording layers. Each time the position of the focus passes a layer, a focussing error signal such as a zero cross point is generated. By counting the number of zero cross points with respect to a reference layer, a desired layer with a ordinal or ranking number with respect to the reference layer is found when the number of zero cross points equals the ordinal or ranking number of the desired layer.

[0003] The total number of recording layers can only be established by counting the total number of zero cross points when changing the position of the focus over the entire range. This requires special circuitry such as zero cross detection means and counter means. Further the result may be error prone as it depends on a measurement.

[0004] European Patent Application EP 0 517 490 A2, which is used for the two-part form delimitation, describes a record carrier having a first and second data surface, the first data surface having header information on the number of surfaces. However, to determine a specific surface, a device will have to count the number of surfaces, by detecting the error signal. This proves to be time consuming.

[0005] However, it is an object of the invention to find the number of information layers in a more convenient and faster way. In accordance with a first aspect of the invention, the record carrier according to the invention is characterized according to the characterizing part of claim 1.

[0006] With this information, a scanning device immediately knows, by simply reading a control block of only one layer, the number of information layers being present.

[0007] A particular embodiment of the record carrier according to the invention is characterized in that the blocks substantially have the same physical location in the plane of the different layers. Consecutive blocks of information can quickly be read one after the other by moving the scanning head to the next information layer over a relatively small distance in the plane of the information layer.

[0008] In a special embodiment of the record carrier according to the invention, at least one of the blocks comprises a sub-block having a global indication about user information stored in the layers. With this information it can be determined in which information layer the information to be read is stored, whereafter the block with the control information on this layer can be read so as to determine the position of the information on the indicated layer.

[0009] The invention also relates to scanning device for scanning a record carrier according to the invention. According to the invention, this device according to the pre-amble of claim 5, is characterized according to the characterizing part of claim 5. The number of information layers thus being determined in a convenient way.

[0010] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment described hereinafter.

[0011] In the drawings:

Fig. 1 shows a record carrier having two information layers according to the invention,
Fig. 2 shows a record carrier and a scanning device,
Fig. 3 shows information areas of two superjacent information layers,
Fig. 4 shows a division of a control block, and
Fig. 5 shows a flow chart for reading a record carrier.

[0012] Fig. 1 shows a disc-shaped record carrier 1. The elevational view shows one of the information layers of the record carrier, with an information area 2 bounded by a circular inner edge 3 and a circular outer edge 4. The information can be stored in, for example circular or spiral tracks in the information layer, in which the information is sequentially ordered from the inner edge to the outer edge of the information area, or conversely. The information may be divided, for example into sectors in which the ordinal number of the sectors increases from the inner edge to the outer edge.

[0013] Fig. 2 is a cross-section of the record carrier 1 and a scanning head of a scanning device 10 for optically scanning the information stored in the record carrier. The record carrier 1 has a transparent substrate 5 provided with a first information layer 6 and a second information layer 8 parallel thereto, separated by a transparent spacer layer 7. Although only two information layers are shown in this embodiment of the record carrier, the number of information layers may be more than two. The spacer layer may be omitted so that the first and second information layers coincide. By storing the information in the first and second layers in a different manner in this case, the information in the first and second layers can be distinguished during reading. The information in the first layer may be stored, for example

in a phase structure, while the information in the second information layer is stored in a magnetization structure. It is also possible to store the two types of information in areas which must be read at different wavelengths.

[0014] The scanning device 10 comprises a radiation source 11, for example a diode laser which generates a radiation beam 12. The radiation beam is formed to a focusing spot 15 via a beam splitter 13, for example a semitransparent plate, and a lens system 14, for example an objective lens. The focusing spot can be placed on any desired information layer by moving the objective lens 14 along its optical axis, as is denoted by the arrow 16. Since the first information layer 6 is partially transmissive, the radiation beam can be focused through this layer on the second information layer 8. By rotating the record carrier 1 about its centre and by displacing the focusing spot in a direction perpendicular to the tracks in the plane of the information layer, the entire information area 2 of an information layer can be scanned by the focusing spot. The radiation reflected by an information layer is modulated by the stored information into, for example intensity or direction of polarization. The reflected radiation is guided by the objective lens 14 and the beam splitter 13 towards a detection system 17 which converts the incident radiation into one or more electric signals. One of the signals, the information signal, has a modulation which is related to the modulation of the reflected radiation, so that this signal represents the information which has been read. Other electric signals indicate the position of the focusing spot 15 with respect to the track to be read. The latter signals are applied to a servosystem 18 which controls the position of the objective lens 14 and hence the position of the focusing spot 15 in the plane of the information layers and perpendicularly thereto in such a way that the focusing spot follows the desired track in the plane of an information layer to be scanned.

[0015] Fig. 3 shows diagrammatically the information area 2 of the information layer 6 in the form of a straight line 20 which extends from the inner edge 3 to the outer edge 4. The line 21 shown above it represents the information area 2' of the information layer 8, extending from an inner edge 3' to an outer edge 4'. Superjacent parts of the lines 20 and 21 are also superjacent in the record carrier 1. At the start of information area 2, i.e. the side of the inner edge 3 of line 20, a control area 22 is reserved for storage of control information. The user information is stored in the area located between the control area 22 and the outer edge 4. The direction in which the user information is stored is denoted by the arrow 23. According to the invention, a control area 24 located above the control area 22 is also reserved in the information area 2'. The user information is stored in the area between the outer edge 4' and the control area 24, the information being sequentially ordered in a direction denoted by an arrow 25 which has a direction opposite to that denoted by arrow 23. The opposite direction of ordering can be realised by providing the information layer 6 with a spiral, outwardly extending track and by providing the information layer 8 with a spiral, inwardly extending track. The user information can then be read by scanning the information area 2 of the information layer 6 from the inner edge 3 to the outer edge 4, displacing the focusing spot from the information layer 6 to the information layer 8, and scanning the information area 2' from the outer edge 4' to the inner edge 3'. The information, ordered in the opposite direction, in the information layers 6 and 8 can be read rapidly one after the other because the focusing spot can be displaced reasonably rapidly from the one to the other information layer in comparison with a displacement of the focusing spot from the outer edge of one information layer to the inner edge of another information layer. In the latter displacement, the time required to change the rotational speed of the record carrier, if this record carrier is of the constant linear velocity type, should also be taken into account.

[0016] The control area 22 comprises various blocks with control information, also referred to as control blocks, each having the same contents. Three of such blocks 26, 27, 28 are shown in the embodiment of Fig. 3. The block is stored three times so as to be able to read the contents in one of the two other blocks if the contents of a block are unreadable because it contains more errors than can be restored by means of a possibly present error-correcting circuit and an error-conrecting code stored on the record carrier. The control area 24, located according to the invention above the control area 22, also comprises three control blocks 29, 30 and 31 with control information for the information layer 8, the information within a block being sequentially ordered in the direction of the arrow 25.

[0017] Fig. 4 diagrammatically shows the division of the control block 26 for the first information layer 6. The block 26 comprises a first sub-block 32 with information about the record carrier as a whole. The information may comprise a type indication of the record carrier, an indication of the number of information layers and the number of blocks of user information in the record carrier, parameters for the radiation beam for writing and reading, information about encryption of the stored information, a table of contents with a global indication of the user information stored in each layer, data relating to a group of record carriers of which this record carrier forms part, and indications of the publisher and manufacturer.

[0018] A second sub-block 33 of the control block 26 comprises information about the information layer on which this block is written. It has, inter alia an indication of the ordinal number of the layer, the number of blocks with user information on the layer and an indication of the type of user information.

[0019] A third sub-block 34 of the control block 26 comprises a table of contents of the information layer on which the control block has been written. The table of contents indicates the initial and final address of each

block of associated user information, a short indication of the user information in each block or an address having such an indication.

[0020] A fourth sub-block 35 of the control block 26 comprises a reallocation table in which reference addresses are mentioned for unwritable and unreadable sectors in the information layer. The fourth sub-block is only necessary on writable media. The control block 26 on the first information layer 6 comprises all of said sub-blocks, while the control blocks on other information layers comprise the second, third and possibly fourth sub-blocks. The other information layers may also comprise a first sub-block.

[0021] The scanning device 10 shown in Fig. 2 is suitable for sequentially reading the blocks of control information before reading the user information. To this end the scanning device comprises means for causing the focusing spot to follow a track, for example in the form of the above-mentioned servosystems, and to displace the focusing spot from one to the other information layer. The last-mentioned displacement of the focusing spot can be realised by means of the servosystem which retains the focusing spot on an information layer.

[0022] The means also comprise a control unit 36 which controls, inter alia the servosystem 18. The control unit operates in accordance with a control program which controls the scanning device in such a way that after correct reading of a control block in the information layer 6 the user information in this layer is not read first, but the focusing spot is displaced towards the information layer 8 in which it reads a control block for this layer. The flow chart of such a control program is shown in Fig. 4 for reading blocks of user information on a record carrier according to the invention. In a first step 37, the focusing spot 15 is placed on the first information layer 6 via the servosystem 18. In a second step 38, the information in the control block 26 on this layer is read. The information comprises the total number of layers N and the ordinal number i of the instantaneously read layer. If $i \neq N$, i.e. all layers have not been read yet, the focusing spot is placed in step 39 on the next information layer and the associated control block is read. If i=N, all control information has been_read. With reference to the information in all control blocks which have been read, it is determined in step 40 which information layer comprises the first block of user information to be read. In step 41, the focusing spot is placed on the relevant information layer and in step 42 it is placed on the location of the block of user information in this layer, whereafter the information in the block is read. If more blocks with user information must be read, the control program returns to step 40 so as to determine the location of the next block from the control information which has already been read.

[0023] The control program may also be used for writing and erasing information in the record carrier. During writing it is determined in step 40 where and on which information layer the block of user information can be written. When subsequently sectors have to be reallocated during writing in said area due to defects in the record carrier, the relevant addresses can be noted in the reallocation table of the control block of the written layer. During erasing, it is determined in step 40 where and on which layer the information to be erased has been written, whereafter the relevant area is erased.

[0024] In many scanning devices, the focusing spot is displaced in the radial direction of the record carrier by means of a two-stage displacement system which forms part of the servosystem 18. The first stage is a relatively slow and large displacement of a slide, the second stage is a relatively small and rapid displacement of the objective lens 14 in the radial direction. For rapid reading of a control block, the radial dimension of a block and preferably the control area is smaller than the maximum radial displacement of the focusing spot 15 caused by the objective lens. This maximum displacement is usually of the order of 100 μm. At a given radius of the control area, the distance between the tracks and information density in the tracks of the record carrier 1, this yields a content of approximately 1 megabyte per control block. If the control information of all information layers should be stored in a single block of 1 megabyte on the information layer 6, it will be evident that space problems are produced in the block when a large number of layers is used. The invention solves this problem by placing the control information associated with an information layer in a block on the information layer itself. The division of other information layers and hence the size of the area for user information can now be independent of the number of information layers.

[0025] It will be evident that said mode of storing information is not limited to record carriers in which control blocks are provided in the manner described hereinbefore, and is neither limited to record carriers which are only suitable to be read by means of a single scanning head.

[0026] It will also be evident that the use of the invention is not limited to disc-shaped record carriers but is also suitable for, for example rectangular record carriers such as memory cards. Although the invention has been explained with reference to an optical record carrier, it will be evident that the invention may alternatively be used for any type of multilayer record carrier which can be read by means of a single scanning head.

Claims

1. A record carrier (1) of the optical type, comprising a transparent substrate (5) and a number of substantially parallel information layers (6,8), adapted to be scanned by means of a radiation beam (12) of a single optical scanning head (10) from the substrate (5) side, each layer (6,8) comprising a block of control information (26,27,28,29,30,31) having information for scanning said layer (6,8), **charac-**

terized in that the block (26, 27, 28, 29, 30, 31) of an information layer (6,8) has an indication about the number of information layers (6,8) recorded in the record carrier (1) and an indication of the ordinal number of the layer.

2. A record carrier (1) as claimed in claim 1, **characterized in that** the blocks (26,27,28,29,30,31) substantially have the same physical location (22,24) in the plane of the different layers (6,8)

3. A record carrier (1) as claimed in claim 2 or 3, **characterized in** the at least one of the blocks (26) comprises a sub-block (32) having a global indication about user information stored in the layers (6,8).

4. A record carrier (1) as claimed in any one of the preceding claims, **characterized in that** said record carrier (1) is disc-shaped.

5. A device for scanning a record carrier (1) of the optical type as claimed in any one of the preceding claims, the device comprising single optical scanning means (10) for focusing a radiation beam (12) on an information layer (6,8), the scanning means (10) comprising

- a radiation source (11) for generating the radiation beam (12),
- a lens system (14) for focusing the radiation beam (12) on a focusing spot (15),
- servo means (18) for controlling the lens system (14) to position the focusing spot (15) of the radiation beam (12) on an information layer (6,8),
- detection means (17) for converting reflected radiation to electric signals and
- a control unit (36) for controlling the servo means (18), **characterized in that** the control unit (36) is adapted to control the servo means (18) to position the focusing spot (15) on an information layer (6,8) to determine the total number of information layers (6,8) and the ordinal number of the layer by reading a block of control information (26, 27, 28, 29, 30, 31) comprising an indication of the number of information layers (6,8) and the ordinal number of the layer in the record carrier (1).

Patentansprüche

1. Aufzeichnungsträger (1) vom optischen Typ, mit einem transparenten Substrat (5) und einer Anzahl nahezu paralleler Informationsschichten (6, 8), ausgebildet, um mit Hilfe eines Strahlungsbündels (12) eines einzelnen Abtastkopfes (10) von der Seite des Substrats (5) aus abgetastet zu werden, wobei jede-Schicht (6, 8) einen Block mit Steuerinformation (26, 27, 28, 29, 30, 31) umfasst, die Information zum Abtasten der genannten Schicht (6, 8) aufweist, **dadurch gekennzeichnet, dass** der Block (26, 27, 28, 29, 30, 31) einer Informationsschicht (6, 8) eine Angabe zur Anzahl von in dem Aufzeichnungsträger (1) aufgezeichneten Informationsschichten (6, 8) und eine Angabe der Ordnungszahl der Schicht aufweist.

2. Aufzeichnungsträger (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Blöcke (26, 27, 28, 29, 30, 31) im Wesentlichen den gleichen physikalischen Ort (22, 24) in der Ebene der verschiedenen Schichten (6, 8) haben.

3. Aufzeichnungsträger (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** zumindest einer der Blöcke (26) einen Teilblock (32) umfasst, der eine globale Angabe zur in den Schichten (6, 8) gespeicherten Benutzerinformation aufweist.

4. Aufzeichnungsträger (1) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der genannte Aufzeichnungsträger (1) plattenförmig ist.

5. Einrichtung zum Abtasten eines Aufzeichnungsträgers (1) vom optischen Typ nach einem der vorhergehenden Ansprüche, wobei die Einrichtung einzelne optische Abtastmittel (10) zum Fokussieren eines Strahlungsbündels (12) auf einer Informationsschicht (6, 8) umfasst, wobei die Abtastmittel (10) umfassen

- eine Strahlungsquelle (11) zum Erzeugen des Strahlungsbündels (12),
- ein Linsensystem (14) zum Fokussieren des Strahlungsbündels (12) auf einem Fokusfleck (15),
- Servomittel (18) zum Steuern des Linsensystems (14), um den Fokusfleck (15) des Strahlungsbündels (12) auf einer Informationsschicht (6, 8) zu positionieren,
- Detektionsmittel (17) zum Umwandeln von reflektierter Strahlung in elektrische Signale und
- eine Steuereinheit (36) zum Steuern der Servomittel (18), **dadurch gekennzeichnet, dass** die Steuereinheit (36) ausgebildet ist, um die Servomittel (18) für das Positionieren des Fokusflecks (15) auf einer Informationsschicht zu steuern, um durch Lesen eines Blockes (26, 27, 28, 29, 30, 31) mit Steuerinformation, die eine Angabe der Anzahl Informationsschichten (6, 8) und der Ordnungszahl der Schicht in dem Aufzeichnungsträger (1) umfasst, die Gesamtzahl Informationsschichten (6, 8) und die Ordnungszahl der Schicht zu bestimmen.

Revendications

1. Support d'enregistrement (1) du type optique, comprenant un substrat transparent (5) et un nombre déterminé de couches d'information pratiquement parallèles (6, 8), conçues pour être balayées à l'aide d'un faisceau de rayonnement (12) d'une seule tête de balayage optique (10) à partir de la face de substrat (5), chaque couche (6, 8) comprenant un bloc d'information de commande (26, 27, 28, 29, 30, 31) présentant de l'information pour le balayage de ladite couche (6, 8), **caractérisé en ce que** le bloc (26, 27, 28, 29, 30, 31) d'une couche d'information (6, 8) présente une indication concernant le nombre de couches d'information (6, 8) enregistrées dans le support d'enregistrement (1) et une indication concernant le nombre ordinal de la couche.

2. Support d'enregistrement (1) selon la revendication 1, **caractérisé en ce que** les blocs (26, 27, 28, 29, 30, 31) présentent pratiquement le même emplacement physique (22, 24) situé dans le plan des différentes couches (6, 8).

3. Support d'enregistrement (1) selon la revendication 2 ou 3, **caractérisé en ce qu'**au moins l'un des blocs (26) comprend un bloc partiel (32) présentant une indication globale concernant l'information de l'utilisateur stockée dans les couches (6, 8).

4. Support d'enregistrement (1) selon l'une des revendications précédentes, **caractérisé en ce que** ledit support d'enregistrement (1) est en forme d'un disque.

5. Dispositif pour le balayage d'un support d'enregistrement (1) du type optique comme revendiqué dans l'une des revendications précédentes, lequel dispositif est muni d'un seul moyen de balayage optique (10) pour la focalisation d'un faisceau de rayonnement (12) sur une couche d'information (6, 8), les moyens de balayage (10) comprenant

   - une source de rayonnement (11) servant à engendrer le faisceau de rayonnement (12),
   - un système de lentilles (14) pour la focalisation du faisceau de rayonnement (12) sur un endroit de focalisation (15),
     des servo-moyens (18) pour la commande du système de lentilles (14) afin de positionner l'endroit de focalisation (15) du faisceau de rayonnement (12) sur une couche d'information (6, 8),
   - des moyens de détection (17) permettant de convertir le rayonnement réfléchi en signaux électriques et une unité de commande (36) pour la commande des servo-moyens (18), **caractérisé en ce que** l'unité de commande (36) est conçue pour commander les servo-moyens (18) afin de positionner l'endroit de focalisation (15) sur une couche d'information (6, 8) afin de déterminer le nombre total de couches d'information (6, 8) et le nombre ordinal de la couche pendant la lecture d'un bloc d'information de commande (26, 27, 28, 29, 30, 31) comprenant une indication concernant le nombre de couches d'information (6, 8) et le nombre ordinal de la couche dans le support d'enregistrement (1).

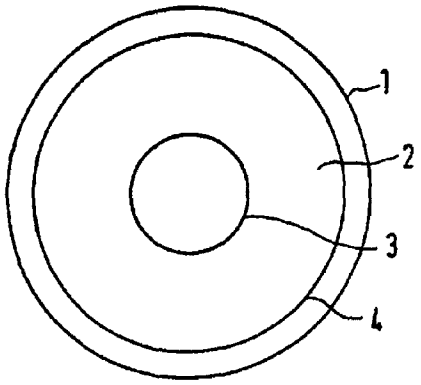

FIG.1

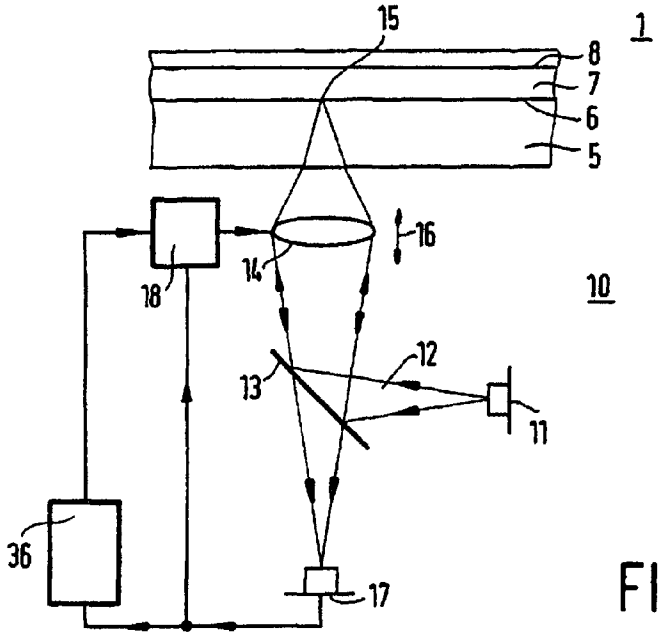

FIG.2

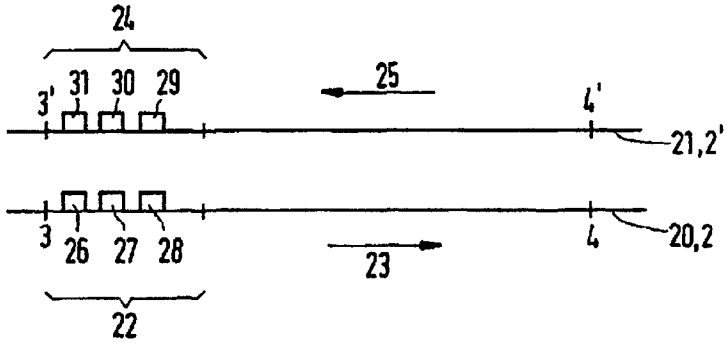

FIG.3

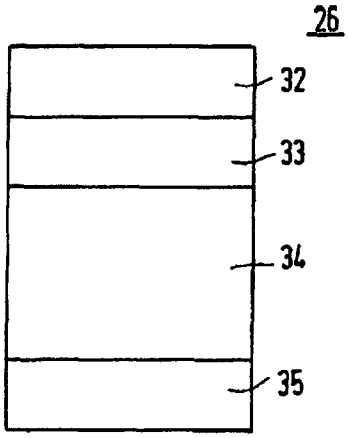
26
32
33
34
35

FIG.4

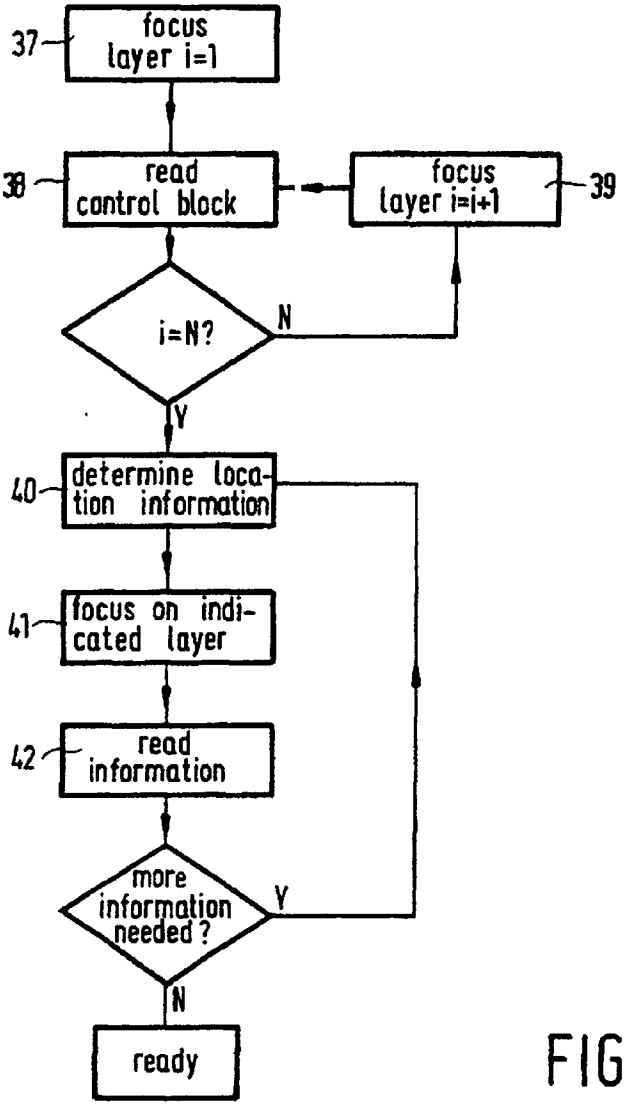
37
focus layer i=1
38
read control block
focus layer i=i+1
39
i=N?
N
Y
40
determine location information
41
focus on indicated layer
42
read information
more information needed?
Y
N
ready

FIG.5